A NEW GENUS, *CALDUKIA*, AND AN EXTENDED DESCRIPTION OF THE TYPE SPECIES, *PROCTONOTUS? AFFINIS* BURN, 1958 (MOLLUSCA GASTROPODA: ARMINACEA, ANTIOPELLIDAE)

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Plate 2, Text Figures 1 and 2.

SUMMARY

A new genus, *Caldukia* (Arminacea, Pachygnatha, Antiopellidae) is described for the wide-spread south-eastern Australian species, *Proctonotus? affinis* Burn, 1958. Special diagnostic characters of the genus are the lamellate rhinophores, a few huge teeth on the jaws, and cuspidate radular teeth.

INTRODUCTION

Both writers recognized at much the same time that a new genus was desireable for a group of Australian and New Zealand species of which *Proctonotus? affinis* Burn 1958 was presently the only described species. In order to establish the concept of the new genus, *Caldukia,* the Australian species has been selected as the type and is here described in detail. Its relationship with other arminaceans is discussed.

Two New Zealand species will be described in the near future by one of us (M. C. M.); one of these species is very close to the Australian type.

DESCRIPTION

Caldukia gen. nov.

Typically antiopellid in basic organization; distinguishable from other genera of the Antiopellidae by the following characteristics. Rhinophores with a very short peduncle; proximal section stout with up to four sloping laminae, upper and lower surfaces of these divided into leaflets which are arranged alternately; distal section narrow, cylindrical and truncate. No inter-rhinophoral crest. Radular formula 6.1.6; rhachidian small, hollowed posteriorly, with a blunt median cusp; laterals strongly cuspidate with a stout base and a crown of up to four cusps. Jaws strong and large; unequal, left larger; right jaw with up to four strong teeth, left usually with two; without a middle piece.

Type species by monotypy: *Proctonotus? affinis* Burn, 1958.

The generic taxon, *Caldukia,* is derived from the Australian aboriginal word 'Kalduke' meaning a bunch of feathers, in allusion to the cerata of the living slugs.

Caldukia affinis (Burn).

Proctonotus? affinis Burn, 1958; 32, text fig. 8, pl.7, fig. 15; 1966: 278.

Material examined: VICTORIA; Torquay, 7 December, 1957, two specimens; Point Lonsdale, 18 November, 1963, three specimens and 21 December, 1964, one specimen: NEW SOUTH WALES; Minnie Waters, near Grafton, November, 1963 (collected by Don McMichael and party).

Habitat: under stones in the Sublittoral fringe.

Morphology (Plate 2; fig. 1, A). See original description for features not mentioned here. Length, extended, up to 15mm. Body lanceolate in outline (broad, rounded end at the front), fairly low slightly arched. Pericardium a prominent elliptical swelling in the middle of the notum. Oral tentacles small, blunt, triangular lobes. Rhinophores (Fig. 1, C) with a very short peduncle; proximal two-thirds stout with up to four, large, sloping laminae, the upper and lower surfaces of a lamina are ridged transversely and these ridges or leaflets are arranged alternately; distal third is narrow, cylindrical and truncate. Cerata fusiform, non-caducous, in up to five longitudinal, staggered rows; cerata smallest at the edge of the notum, becoming progressively larger towards the centre. Anus at the tip of a large papilla situated in the mid-line near the rear of the notum. Reproductive apertures on the right side, just below the edge of the notum and about midway between the rhinophores and the front of the pericardium. Renal aperture on the right side, just below the edge of the notum and about level with the posterior end of the pericardium.

Colour. See original description.

Alimentary System (Fig. 1, B). Oral tube short and wide, leads to the buccal mass which is massive, ovate in outline (when viewed from above) and flattened dorso-ventrally. The salivary glands are huge folliculose bodies which lie close to the sides of the oesophagus and the ventrolateral walls of the stomach; the ducts enter the buccal mass on either side of the oesophagus. The oeso-

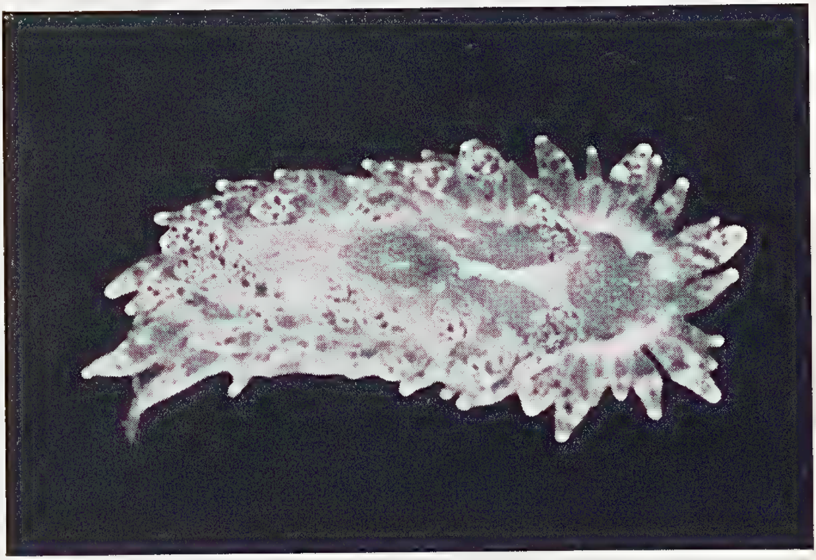
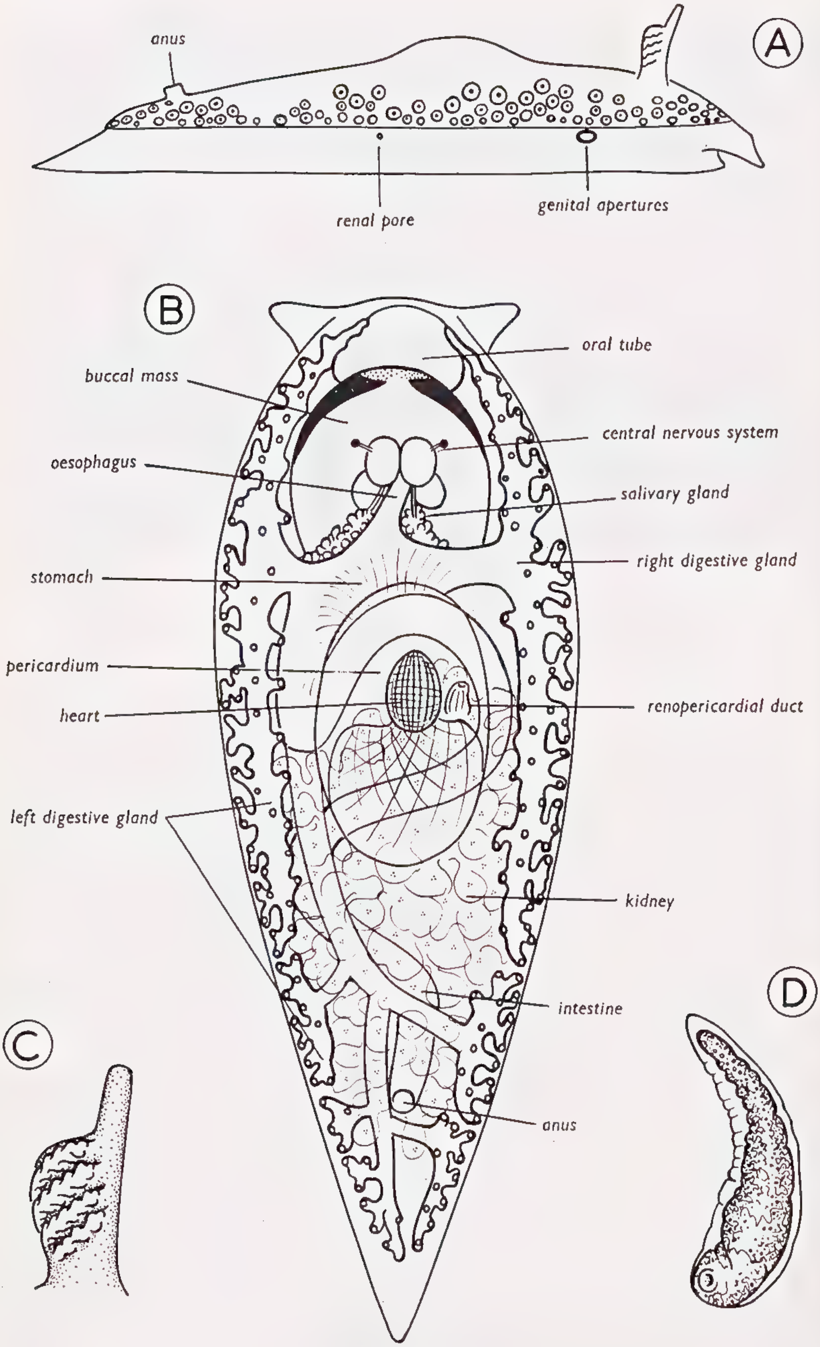


Plate 2. *Caldukia affinis* (Burn). A specimen from Long Reef, New South Wales. Photographed in colour by A. Healy, black and white print by G. Batt.

phagus, which is wide and muscular, leads into a large, crescentic (in outline), muscular stomach. There are three main (stomachal) ducts of the digestive gland; the right and left anterior ducts are extremely short and each forms a T-junction with a large longitudinal duct which runs along the edge of the anterior two-thirds of the notum. Lateral branches, simple or divided, arise along both the inner and outer edges of the longitudinal duct. The left posterior duct is long; it arises close behind the opening of the left anterior duct, runs down the left side of the gonad for a short distance and then gradually curves over to the right — here it gives off, to the left, the first lateral duct. On reaching the mid-line, the main duct sends out the first right lateral duct; the main duct then bends to run posteriorly, parallel with the intestine. More lateral branches issue from the left side of the main duct. Immediately behind the anus a large branch is given off to the right. Like the main anterior ducts, all but the most posterior of these lateral ducts run into a longitudinal duct which gives off short lateral branches. Diverticula to the cerata arise singly from the longitudinal ducts and side branches. The diverticulum (Fig. 1, D) is simple and extends almost to the tip of the ceras. The intestine arises on the left side from the posterior end of the stomach; it bends immediately through 180 degrees and then curves sharply to the right below the front of the pericardium. On the right side the



Text Figure 1

intestine continues to bend and passes beneath the hermaphrodite gland to run back to the left side, where it immediately curves round to the top of the gonad, a little distance behind the pericardium, then passes below the first right lateral branch of the posterior duct of the digestive gland and finally straightens out to run along the mid-line to the anus.

Buccal Armature (Fig. 2, A and B). Radular formula 6-1-6. A 15 mm. individual had a radula with 26 (including 8 developing) rows of teeth. Central tooth small, with sides diverging posteriorly and a curved rear edge; posterior face concave, upper edge notched to form a blunt median cusp. First (the innermost) lateral tooth has a rectangular base surmounted with four cusps. Second to fifth laterals have a curved base which is drawn out into a bluntly pointed arm towards the side of the radula. The second lateral has four cusps (a small one to the rear), the third and fourth have three, the fifth has two and the sixth has one — in each the middle cusp is the largest. Except for the sixth (the outermost), all of the teeth resemble the carnassials of members of the mammal order Carnivora. Jaws, strong, unequal, left larger than the right. Right jaw roughly rectangular in outline with four large, dark yellow teeth; left jaw ovate though the lower margin is almost straight, usually with two large teeth. Jaws firmly united above by a thick band of chitin.

Nervous System. Investigated superficially: cerebral and pleural ganglia fused; fairly long optic nerves.

Kidney. Extensive, filling the dorsal region of the body cavity from the middle of the pericardium to the anus. It is highly branched and these branches or pockets are so compacted as to give the organ an alveolate appearance. The renopericardial duct (Fig. 1, B) lies to the right and just within the anterior half of the pericardium; it is fairly large and folded internally.

Reproductive System (Fig. 2, C). Hermaphrodite gland massive, filling most of the body cavity between the stomach and the anus. Follicles large, ovate, opening singly by a narrow duct into the main hermaphrodite duct which in turn runs forward to a globula ampulla. A common duct leaves the right side of the ampulla and bifurcates. The anterior branch is the vas deferens; the first third of this duct is very narrow, the following section is wide and prostatic. The penis (Fig. 2, D) is fairly long, conical and unarmed. The posterior branch of the common duct is the oviduct; there is a swelling near the junction which is probably the fertilization

Fig. 1. *Caldukia affinis* (Burn). A, view of the right side showing the insertions of the cerata and the positions of the various apertures; B, dorsal view of the general anatomy (reproductive system not shown); C, side view of a rhinophore; D, a ceras, preserved (stained with borax carmine and cleared in cedarwood oil).

chamber; from this chamber the oviduct, which is very narrow here, curves to the right and opens into the female gland near the opening of the 'vagina', a fairly long duct which connects the spherical bursa copulatrix to the female atrium.

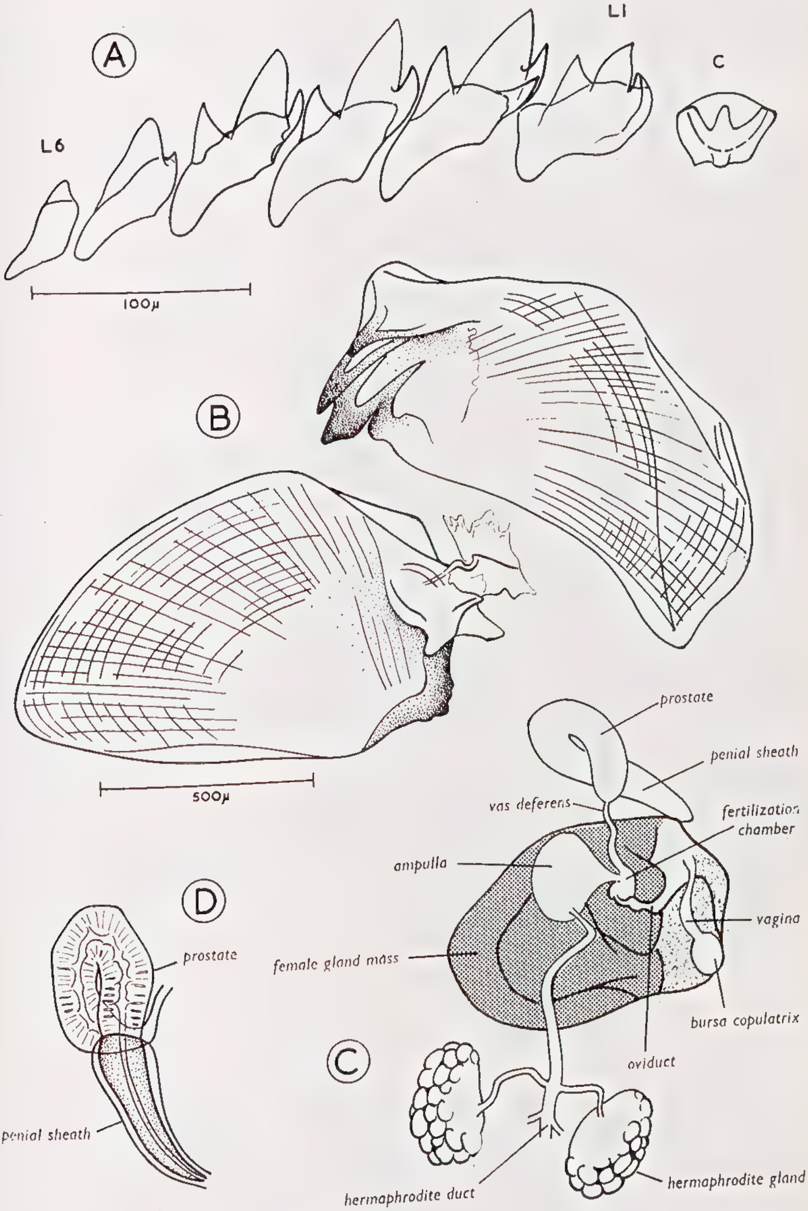
DISCUSSION

Eolidiform bodies, non-retractile laminate, papillate or roughened rhinophores, and thick jaws with large masticatory borders are the characteristics uniting the three families Antiopellidae, Madrellidae and Dironidae into the superfamily Pachygnatha (Odhner, 1939: 48). The first family is separated by the position of the anus in the posterior mid-dorsal line and the presence of the digestive gland in the cerata from the other two families where the anus is lateral to the cerata and the digestive gland terminates at the ceratal base. Smaller numbers of specially adapted teeth in the radulae, 1.1.1 in the Madrellidae and 1.1.1.1.1 in the Dironidae, further separate these families from the Antiopellidae with a greater number of rather uniform smooth, denticulate or cuspidate teeth either side of the naked or dentate rhachis. A seminal vesicle or prostate gland attached by a slender duct to the penial sheath in the Madrellidae does not occur in the other families.

Until now, only three genera have been ascribed to the Antiopellidae; *Janolus* Bergh (1884), *Antiopella* Hoyle (1902; = *Janus* Verany, 1844, = *Antiopa* Alder and Hancock, 1848, both preoccupied), and *Proctonotus* Alder and Hancock (1844; = *Zephryina* Quatrefages, 1843, according to Pruvot-Fol, 1954: 372; = *Venilia* Alder and Hancock, 1844, pre-occupied). Even a family name acceptable to all authors remains in dispute; alternative names used at various times include Janidae, Janolidae, Zephryinidae, and Proctonotidae.

Of the four genera, *Proctonotus* stands somewhat apart, because it lacks an inter-rhinophoral crest (as does also *Caldukia*) and possibly a rhachidian tooth in the radula. *Antiopella* and *Caldukia* have smooth cerata in which the digestive gland is slender and generally branching in the former, and shorter and simple in the latter. *Janolus* and *Proctonotus* have knobbed cerata and simple short digestive glands. The heavy rhinophoral laminae of *Caldukia* are closer to the posteriorly prominent transverse laminae or papillae of *Janolus* than the the slended oblique ribbing of *Antiopella*

Fig. 2. *Caldukia affinis* (Burn). A, radular teeth, a half-row (C, central or rhachidian tooth; L. lateral teeth); B, jaws, view of inner surface (note: left jaw with only one tooth, usually there are two); C, reproductive system, unravelled; D, penis, preserved (stained with borax carmine, cleared in cedarwood oil).



Text Figure 2

and the Dironidae. The rhinophores of the Madrellidae have tubular papillae at the distal anterior side of the stalk, not at mid-length as in the new genus.

The buccal parts have rather uniform jaws, differing only by variation of the masticatory borders; smooth in *Janolus*, small toothed in *Antiopella* and *Proctonotus*, large toothed in *Caldukia*. Radulae too vary only slightly in the older genera; *Proctonotus* has smooth teeth and an inconspicuous or absent rhachidian, *Antiopella* has the rhachidian and at least the first lateral denticulate in all rows, *Janolus* has only the oldest teeth denticulate, adult specimens generally have all teeth smooth in fully developed rows. *Caldukia* has a specialized radula with a virtual three cusped rhachidian and up to four strong cusps on the lateral teeth.

The reproductive systems of the three older genera are insufficiently known to gauge generic characters with any certainty. The male copulatory organ in *Antiopella* is generally a thick conical papilla *(cristata*, Bergh, 1874: pl. 7, fig. 16; *mucloc*, Marcus, 1958: 40, fig. 71; *barbarensis*, MacFarland, 1966: 308, pl. 64, fig. 11, 15) as in *Caldukia*. In at least two species of *Janolus*, this organ is a slender straight papilla *(flagellatus*, Eliot, 1906: 375; *comis*, Marcus, 1958: 34, fig. 61). In three figures of *Antiopella* and one of *Janolus*, the position of the spermatheca or bursa copulatrix varies greatly. It lies at the top or inner end of the vagina in *A. cristata* (Alder and Hancock, 1854: pl. 43, fig. 9) and *A. muscloc* (Marcus, 1958: 40, fig. 71), and at the inner end of the ampulla in *A. barbarensis* (MacFarland, 1966: 307, pl. 64, fig. 11, 13). In *J. comis* (Marcus, 1958: 37, fig. 61), the uterine or insemination duct joins the bursa copulatrix in a ' serial ' fashion, that is the vagina and uterine ducts are at opposite sides of the bursal dilation. *Caldukia affinis* has the bursa at the end of a long duct-like vagina, somewhat as in *Antiopella.*

DISTRIBUTION

C. affinis is widespread in south-eastern Australia. In Victoria, it is not uncommon at Torquay and Point Lonsdale and has been collected at Port Fairy and San Remo. It has been rarely taken in New South Wales, at Manly Baths in Sydney Harbour and at Long Reef on the open coast a few miles to the north, and a single specimen was collected at Minnie Waters, east of Grafton on the northern coast. Two Tasmanian specimens are known, both from Greens Beach, Kelso, on the Tamar River. All specimens have been collected either under stones or crawling on algae at low tide level; the food of the species has not yet been established.

REFERENCES

ALDER, J. and A. HANCOCK, 1845 - 1855. *A Monograph of the British Nudibranchiate Mollusca.* London (Ray Society).

BERGH, R., 1874. Beitrage zur Kenntniss der Aeolidiaden. I. *Verh. Zool. Bot. Ges. Wien*, 23 1873): 596-628, pl. 7-10.

BURN, R., 1958. Further Victorian Opisthobranchia. *J. Malac. Soc. Aust.*, 2: 20-36.

———, 1966. Port Phillip Survey 1957-1963. Opisthobranchia. *Mem. Nat. Mus., Melb.*, 27: 265-288.

ELIOT, C., 1906. Notes on some British Nudibranchs. *J. Mar. Biol. Ass. U.K.*, 7: 333-382, pl. 11-12.

MACFARLAND, F., 1966. Studies of opisthobranchiate mollusks of the Pacific coast of North America. *Mem. Calif. Acad. Sci.*, 6: 1-546.

MARCUS, E., 1958. On Western Atlantic opisthobranchiate gastropods. *Amer. Mus. Novitates*, no. 1906: 1-82.

ODHNER, N., 1939. Opisthobranchiate Mollusca from the western and northern coasts of Norway. *K. Norske Vidensk. Selsk. Skr.*, 1939, no. 1: 1-93.